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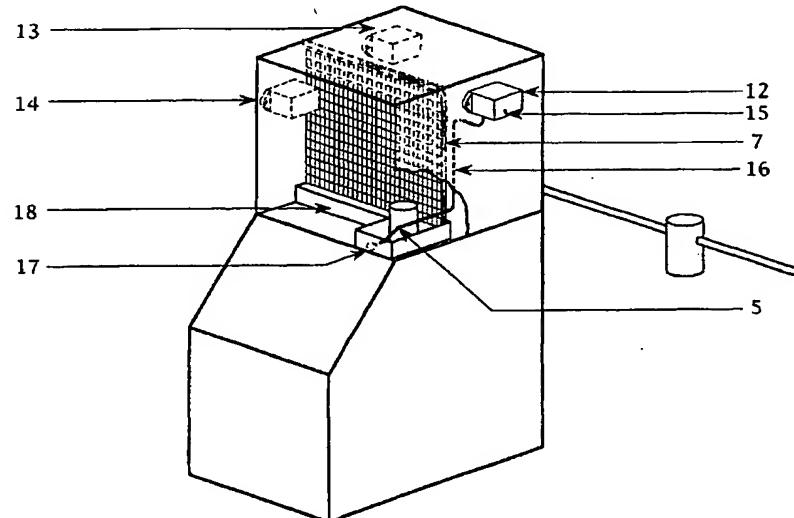
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(54) Title: REFRIGERATION PURIFIERS



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(57) Abstract: A method and apparatus for the continuous or periodic cleaning and purification of water or air or surfaces in refrigeration systems, such as ice machines and refrigerated containers. Oxidants and oxidant radicals are produced electrically in a stream of air and the resultant gas is injected into a stream of water or air which flows through the refrigeration system and where further oxidants may be generated in this downstream flow of water or air.

TITLE

## REFRIGERATION PURIFIERS

Refrigeration Purifiers are products, which control the quality of air, water and surfaces in refrigeration systems. These systems comprise a refrigeration unit or plant, which is used to cool air or water or produce. The refrigeration unit may be an integral part of a refrigeration machine (such as an Ice Machine) or may be used to create a refrigerated space (such as a Cool Room).

## 10 BACKGROUND OF THE INVENTION

Refrigerated machines include Ice Machines, Drinking Water Coolers and Water Fountains. Such machines contain water and various electrical and mechanical components. The water may be recirculated and/or may interface with air. Therefore pollutants may build up in the liquid or frozen water, on component surfaces and in air spaces either within the machine or at exit points from the machine. Pollutants can include micro-organisms, organic load, scale, off-odours, off-tastes and off-colours. Some refrigerated machines purge water to control pollutants and therefore water wastage occurs.

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Refrigerated spaces include cold rooms, cool rooms, refrigerated ship containers, refrigerated trucks, commercial refrigerators and residential refrigerators. Such spaces contain air and produce. The air is generally recirculated around the space and repeatedly through the refrigeration unit.

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The air is cold and therefore water vapour tends to condense, creating a moist environment. Pollutants may build up in the air, on produce surfaces and in water aerosols. Pollutants can include micro-organisms, organic load, ethylene and scale. Some produce is typically wasted in refrigerated spaces.

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Refrigerated systems, such as refrigerated machines and refrigerated spaces need to be kept clean. Cleaning is also referred to as purification or sanitation or disinfection. Cleaning may be periodic or continuous.

An example will now be given of an indicative refrigerated machine, namely an Ice Machine. Ice Machines are products which use refrigerants to cool water to create ice. They are used in houses, commercial premises and industrial

5 premises. In some applications they are connected to ice dispensing machines or post-mix syrup machines or drink dispensers to supply the ice to various locations. They are common throughout the world in hotels, clubs, commercial kitchens, pubs, restaurants, bars, home refrigerators and industrial premises.

10 An Ice Machine is shown conceptionally in Figure 1.

The Ice Machine comprises three main chambers. The first chamber may be called the refrigeration unit 2 and comprises the components which generate cold conditions such as a compressor, refrigerant, coolant coils and so on. The

15 second chamber is adjacent to the first and may be called the ice rack chamber 3. This chamber comprises the ice racks 4, a fluid transfer device 5 (in this case a water pump), a water reservoir 6, and a pipe 7 which has water delivery holes 8. Water regularly circulates within the Ice Machine. The third chamber is the hopper 9, and may be located beneath the first two chambers. The ice machine

20 is of course connected to a water supply 10, which may be filtered 11, either close to the machine, or where the mains water supply enters the premises. Some water may exit the system as "bleed or dump or purge water" so as to remove pollutants through an exit pipe 1. Many variations of this layout are possible.

25 A typical mode of operation for an ice machine is now described. An ice making cycle may take 10 to 60 minutes for example and begins when water enters the machine, determined by the various controls, which may operate watervalves. This water fills up the reservoir 6. The water pump 5 then pumps water up the

30 pipe 7 and the water runs out holes 8 and down, under gravity, over the ice racks 4. Therefore the water flows through air. The water is then captured in the reservoir again and recirculated. The components in the refrigeration chamber

serve to cool the ice racks 4 and thus ice is produced. The ice may then be released into the hopper 9, either via a mechanical movement or by a reverse cycle refrigeration system, whereby the ice racks are temporarily heated. A sensor in the hopper may control the operation, based on the ice supply and demand rates. Many variations of this operation are possible.

An example is now given of an indicative refrigerated space, namely a refrigerated container. Refrigerated containers are used to transport food produce on ships, trains, aircraft and trucks. They comprise a refrigeration unit attached to one end of a container. Air recirculates throughout the space and repeatedly through the unit, where it is cooled.

A refrigerated container is shown conceptionally in Figure 2.

15 The refrigerated container contains two main chambers. The first chamber may be called the refrigeration chamber 2 and comprises the components which generate cold conditions such as compressor, refrigerant, cooling coils and so on. The second chamber is adjacent to the first and may be called the Produce Chamber 3. This chamber comprises produce, insulation, an access door and so on. A fluid transfer device 5 (in this case an air fan) causes air to recirculate between the two chambers. Some air may exit the system as waste air so as to remove pollutants, including ethylene through an exit vent 1. Many variations of this layout are possible.

25 A typical mode of operation for a refrigerated container is now described. Air is sucked from the top of the produce chamber 20, through the fan 5, and into the refrigeration chamber 2 where it is cooled and possibly dried as it passes downwards through the cooling coils. It then is forced from the base of the refrigeration chamber 21 back into the produce chamber where it flows through flutes and then upward 22 to cool the produce. Many variations of this operation are possible.

The art concerns air, water and surface quality control devices in refrigeration systems where water or air are always present as working fluids and are cooled. Therefore the quality of the water and the air are important for reasons of human health and safety and they are also important for reasons regarding effective operation of the refrigeration system.

The various pollutants and cleaning responses, which are common to various refrigeration systems, are now described:

Various pollutants enter the refrigeration machine or space either through water or air or human contact or the presence of produce. If the supply of air or water is not correctly filtered, then air or water or surface pollutants may exist. Consequently, pollution can build up inside the refrigeration machine or space. This includes bio film or bio slime. Other microbes can also build up such as bacteria, viruses, algae, fungi and protozoa. Other pollutants include salts and scale, odour, off-colours and off tastes. These pollutants can cause the water or produce itself to be unhealthy or unpalatable or unhygienic. The bio film is unsightly and in some instances can cause visible black flakes to be deposited in ice or water.

In the case of refrigerated spaces, which contain food produce, it is important to maximise shelf life and to minimise food spoilage. Spoilage is caused by surface microbes on the food produce and/or by the generation of ethylene from the food produce as it ripens, which in turn, causes faster decomposition. Such refrigerated spaces may exit some air from the space to remove ethylene, but this reduces cooling efficiencies. Other refrigerated spaces are filled continuously with chemicals or modified atmospheres in order to increase shelf life, but this is expensive.

On some premises, yeast is present. Examples are premises where bread is made in the kitchen. In such cases, the degree of bio film can be excessive.